ON THE STRUCTURE AND CLASSIFICATION OF THE STROMATOPOROIDEA[1]

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In the course of my studies on the numerous stromatoporids from the Rhenish Devonian which are in the Geological Institute of the University of Bonn, among them the types of Goldfuss and Bargatzky, I have come to hold a view concerning the structure and especially concerning the classification of the Stromatoporoidea which is not in harmony with the one now generally accepted.

Since the publication of my complete work, which will appear under the title, *Studien in den Riffkalken des rheinischen Mitteldevon. I. Teil: Biologie, Morphologie und Genesis der Riffe des rheinischen oberen Mitteldevon. II. Teil: Revision der Stromatoporen* is still somewhat distant, I will present here the results of the second part, leaving the detailed evidence to follow in the complete work.

It is apparent from all textbooks on paleontology and also from the often exhaustive works of recent students of this debatable subject (Parks and others), that since 1886–92 the view of Nicholson has been generally followed and the Stromatoporoidea therefore divided into two groups. The "milleporoid" group includes the forms which possess the so-called "zoöidal tubes"; and the other or "hydractinoid" group, those without such structures. To the first group are referred the families Stromatoporidae Nicholson and Idiostromidae Nicholson; to the second, the families Actinostromidae Nicholson and Labechidae Nicholson.

It now appears: (1) that the families Labechidae Nicholson and Idiostromidae Nicholson should be taken out of the order Stromatoporoidea, since their organization has scarcely anything in common with that of the remaining Stromatoporoidea. By means of this division, a simple, clear definition is obtained for the

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"true" Stromatoporoidea. (2) That the division into a "milleporoid" and a "hydractinoid" group must give way to another, since the distinction on which it rests is not present.

Next should be discussed the families which in my opinion have been incorrectly referred to the Stromatoporoidea, i.e., Idiostromidae Nicholson, with the genera *Amphipora* Schulze, *Stachyodes* Bargatzky, and *Idiostroma* Winchell, and Labechidae Nicholson, with the genera *Labechia* Edwards and Haime, *Rosenella* Nicholson, and *Beatricea* Billings.

In *Amphipora*, the old conception is to be replaced by that of Felix (1905), which I found confirmed in hand specimens from Letmathe and elsewhere in which the fossil had not yet been weathered out. According to this, around a non-tabulate axial canal, about 0.75 mm. wide, are grouped closed cells, which increase in size outward.

In *Stachyodes*, the original view of Bargatzky (1881) must be restored, which stated that from a non-tabulate axial canal there branch off non-tabulate lateral canals which in turn branch repeatedly. The wall structure of the canals is massive but seems to be perforated in places.

Idiostroma also has a non-tabulate axial canal, arising out of the openings, which bear apically calcareous interfingering lamellae. Otherwise the lamellae are only slightly perforated. They are supported at intervals by little walls and pillars. These are arranged more or less in the form of parabolas which extend from the apex backward. They leave between them a labyrinth of passages which also extend from the apex (the axial tube) backward. The passages of one and the same interlamellar cavity are well connected with one another, but seldom with those of the neighboring spaces, since the lamellae seldom show a pore.

In all three genera one misses the meshy structure as well as the astrorhizae of the "true" Stromatoporoidea, aside from the fact that these fossils never have a treelike appearance or anything like it.

Again, the skeleton of the Labechidae is not at all stromatoporoid, having no network of meshes open on all sides, but rather a complex of circular, closed, flat vesicles, which, according to the

genus, are broken through by pillars (*Labechia*), show reduced pillars on the convex side (*Rosenella*), or are free from pillars (*Beatricea*). Here is to be noted also, as an important negative characteristic, the absence of astrorhizae.

When, therefore, the families Labechidae and Idiostromidae are thus removed, the Stromatoporoidea no longer stand as a collective group of elements of unequal value, but the remaining "true" Stromatoporoidea represent a clearly limited order, for which the following definition may be given: The skeleton is built of seamlessly united, massive or porous calcareous fibers, which form a more or less regular network. In this can be recognized a more or less plainly layered arrangement of the tangential elements. Astrorhizae are always present.

From the examination of a greater mass of material it appears that in the skeletal structure of the Stromatoporoidea all transitional stages from regularly netted (reticulate) to markedly vermiform (vermiculate) are present. The division into a "hydractinoid" and a "milleporoid" group is incorrect, since it is founded upon a wrong supposition, for in none of the forms which were put into both groups are "zoöidal tubes" analogous to those of *Millepora* present. In fact, G. Steinmann in 1903 (*Milleporidium*, etc.) and W. Parks in 1909 (*Silurian Stromatoporoidea*, etc.), the former strongly, the latter at first doubtfully, questioned the so-called "zoöidal tubes."

A still sharper division into two groups lies in the fact that the relatively fine fibers of the family Actinostromidae are massive, while the somewhat thick fibers of the family Stromatoporidae show pores and little canals. On this ground a division of the Stromatoporoidae must rest.

This division principle: "Fibers massive"—"Fibers not massive" permits of an unquestionable division. Moreover, it is in harmony with the fact that in the massive-fibered group belong only entirely rectilinearly and altogether regularly built forms, while to the hollow-fibered group may be referred only those forms which are in some way irregularly vermiculate in their skeletal structures. The further division into genera rests in both groups on the degree of regularity of the skeletal mesh. It is, however, no

longer quite so sharp, since in many forms it is not certain whether they have a greater or less degree of regularity and so are to be referred to this or that genus. The differentiation into species is at best dependent upon the number of lamellae and pillars per millimeter, while the development of the astrorhizae and the tubercles, on account of their variability, comes into consideration only secondarily, and in extreme cases can only lead to the making of varieties.

It is especially to be noted in the work of Parks, who has recently published various studies on American stromatoporids, that often in one and the same specimen the conditions, e.g., the number of pillars and lamellae, vary so much that one cannot be too cautious in the making of new species, if the specimens are to be identified.

In accordance with the principles above stated, the following classification may be formulated:

A. Family Actinostromidae Nicholson. Fibers massive.
Radial and tangential elements equally well developed and united into a linear network (rectilinear). (Surface therefore granular.)
I. Pillars passing continuously through several lamellae: Genus *Actinostroma* Nicholson.
II. Pillars only one lamella high:
1. Lamellae quite flat: Genus *Clathrodictyon* Nicholson.
2. Lamellae strongly vaulted: Subgenus *Stylodictyon* Nicholson and Murie.

B. Family Stromatoporidae Nicholson. Fibers not massive (porous or perforate).
I. Radial and tangential elements equally strongly developed and plainly differentiated. Tangential section, however, in part vermiculate. (Surface therefore in great part granular, but in places vermiculate.)
1. Pillars passing through: ?Genus *Hermatostroma* Nicholson.
2. Pillars generally only one lamella high: Genus *Stromatoporella* Nicholson.
II. Radial elements somewhat rectilinear and strongly prominent as compared with the much thinner tangentials. Tangential section vermiculate. (Surface vermiculate.) Genus *Parallelopora* Bargatzky.
III. Radial and tangential elements equally strongly, very irregularly interlaced (vermiculate) and therefore no longer differentiated. Tangential and radial sections vermiculate. (Surface vermiculate.) Genus *Stromatopora* Goldfuss.